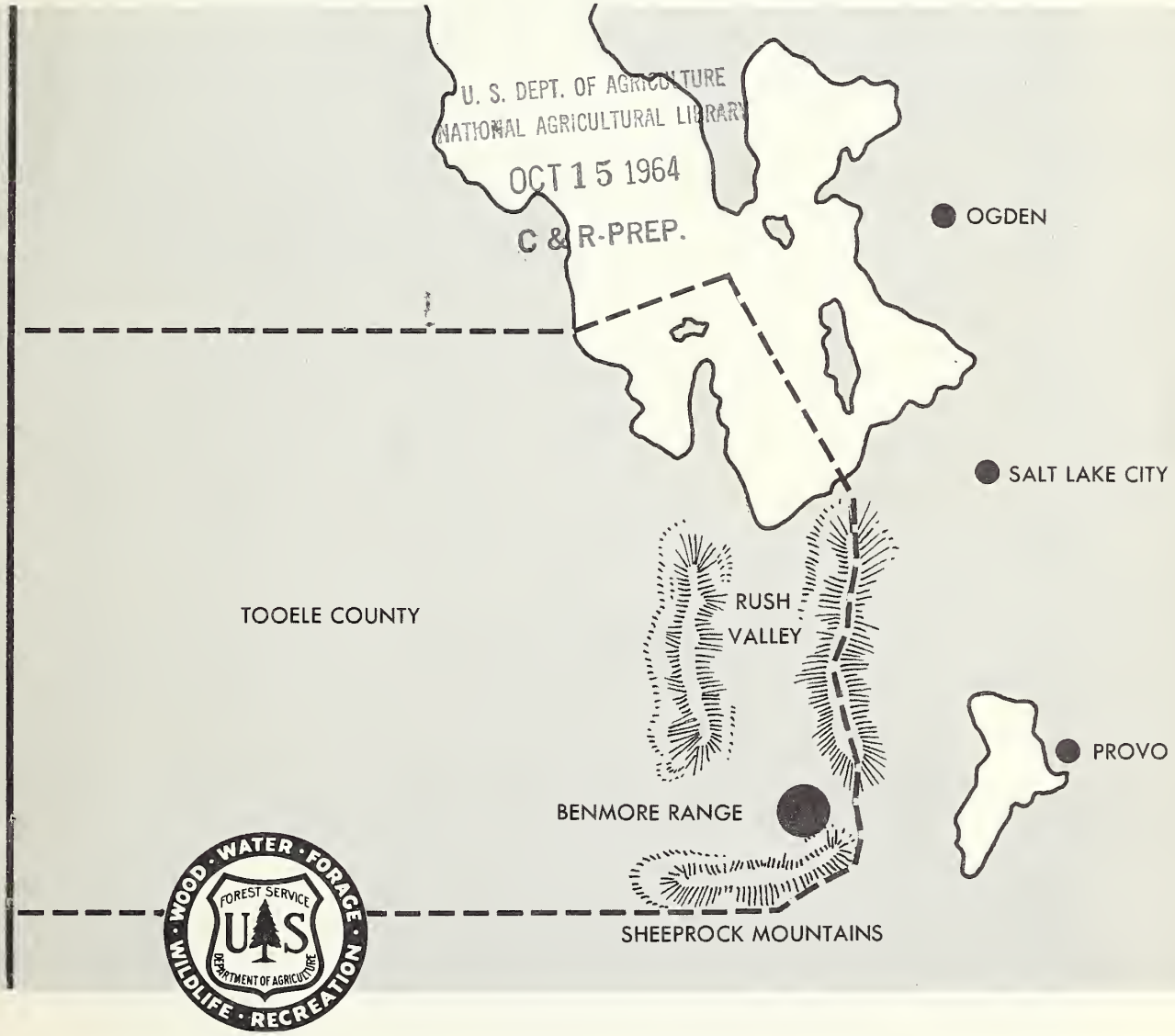
The BENMORE EXPERIMENTAL RANGE



Maintained by Intermountain Forest and Range Experiment Station, Forest Service, U. S. Department of Agriculture, in cooperation with Utah State University and the Wasatch National Forest.

Stockmen from the Benmore area cooperate with Forest Service and Utah State University researchers in checking and weighing cattle.

THE BENMORE EXPERIMENTAL RANGE

The area. The Benmore Experimental Range, some 3,200 acres in the southeastern corner of Tooele County, lies about 60 miles southwest of Salt Lake City at an elevation of about 5,700 feet. This is spring-fall range, bounded on the north by salt-desert winter range, and on the south by the mountainous summer range of the Sheeprock Mountains. The south end of Rush Valley, where the range is located, is generally level, though broken by shallow, intermittent stream channels.

Its history. The Benmore area was named for two early families, the Bennions and the Skidmores. They and other pioneers in the valley, impressed by the abundance of native grasses, grazed their stock on the range the year around, when snow conditions permitted. In time, as the capacity of the grasses to regenerate was exceeded, grass stands deteriorated, sagebrush increased, and range productivity declined.

Brush invaded overgrazed range at Benmore . . .

Attempts at dryfarming failed . . .

Dryfarming. Shortly after 1900, large tracts of sagebrush-grass range were plowed for dryfarming. Fair to good yields of grain were obtained in seasons of average rainfall, but years of low rainfall were too frequent for profitable farming. Although annual precipitation in this century has averaged almost 13 inches, the annual average from 1928 to 1935 was only slightly more than 9 inches —an amount insufficient for dryland grain farming.

Federal purchase. Failure of dryfarming led to the purchase of some 45,000 acres in the midthirties by the National Resources Committee. After purchase, management of the area was entrusted to a succession of government agencies: the Resettlement Administration, the Bureau of Agricultural Economics, the Soil Conservation Service, and in 1954 the Forest Service.

Ranges established. Under Federal management, 3,200 acres of this land were fenced in and designated experimental range. Twenty-eight 100-acre pastures were fenced and seeded to grass, a 280-acre holding pasture was established, and 160 acres were set aside for reseeding studies. Federal agencies also installed a 5,000-gallon tank, two storage reservoirs, pipelines to the pastures, and drilled a well.

Grass seeding. These experimental ranges contain some of the oldest large-scale plantings of crested wheatgrass in the Intermountain West. In the original plantings in 1938 and 1939, fairway or crested wheatgrass was seeded at 2.5 pounds per acre and other grasses were seeded in lesser amounts. Parts of some pastures with poor initial stands were subsequently reseeded at the rate of 4 pounds of crested wheatgrass per acre. The seeded areas were protected from grazing until 1943.

Then experimental reseeding with crested wheatgrass was tried . . .

. . . *and water provided. Ample fresh water has contributed to high gains of cattle grazing seeded ranges at Benmore.*

Crested wheatgrass on the Benmore range – excellent spring range for cattle. It is ready for grazing about 2 weeks earlier than native range and provides gains double those on unseeded ranges at Benmore.

EARLY GRAZING STUDIES

An early objective of research by the cooperating agencies (U. S. Forest Service, Utah State University, and the Soil Conservation Service) was to compare grazing on seeded range with grazing on the adjacent, depleted range. By 1943, fall grazing was permitted on all pastures; spring grazing was combined with fall grazing on selected pastures from 1944 to 1946 to test yields and grazing capacities. The comparisons revealed:

- Crested wheatgrass range was ready for grazing about 2 weeks earlier than native range.
- About 2.5 acres of crested wheatgrass range would carry a mature cow for 1 month, whereas the same animal would have to graze 12 to 25 acres of depleted sagebrush range per month.
- Daily gains on seeded range averaged about 3 pounds per cow, in contrast to gains of about half that amount per cow on depleted range. Moreover, cattle that entered seeded pastures in poor condition in April were usually "grass fat" when they left for summer range in June, but cattle on the native range remained poor.
- Increased carrying capacity of the seeded pastures permitted range managers to reduce grazing on adjacent mature brush range. After 15 years of light fall grazing, much of the unseeded native range is now in good condition.
- The increased grazing capacity of the spring-fall pastures has enabled range managers to shorten the grazing season on summer range by 2 months.

- The uniform breeding season for cattle on seeded range has resulted in a 95-percent calf crop—about 30 percent higher than that for cows on unseeded range, where bulls and cows are run together for the entire grazing season.
- Calves from this area command premium prices because they are in top shape at weaning.

LATER STUDIES

Improving methods of grazing. Range managers were interested not only in determining the relative advantages of seeded over unseeded ranges, but also in developing the best methods of grazing improved rangeland. In 1948 they began testing 12 different systems of spring grazing. These studies continued for 11 years and involved twenty-eight 100-acre pastures. (Four pastures were used for holding stock and the other 24 for testing the methods in duplicate.) The 12 methods consisted of combinations of four systems and three intensities of grazing:

1. **Rotation.** Pastures subdivided into three units, cattle shifted from one unit to another. Each unit grazed twice during the 60-day spring season (April 20-June 20).
2. **Continuous.** Pastures grazed continuously for the 60-day grazing season (April 20-June 20).
3. **Delayed.** Beginning of 50-day grazing season delayed 10 days (May 1-June 20).
4. **Shortened.** Grazing terminated at 50 days (April 20-June 10).

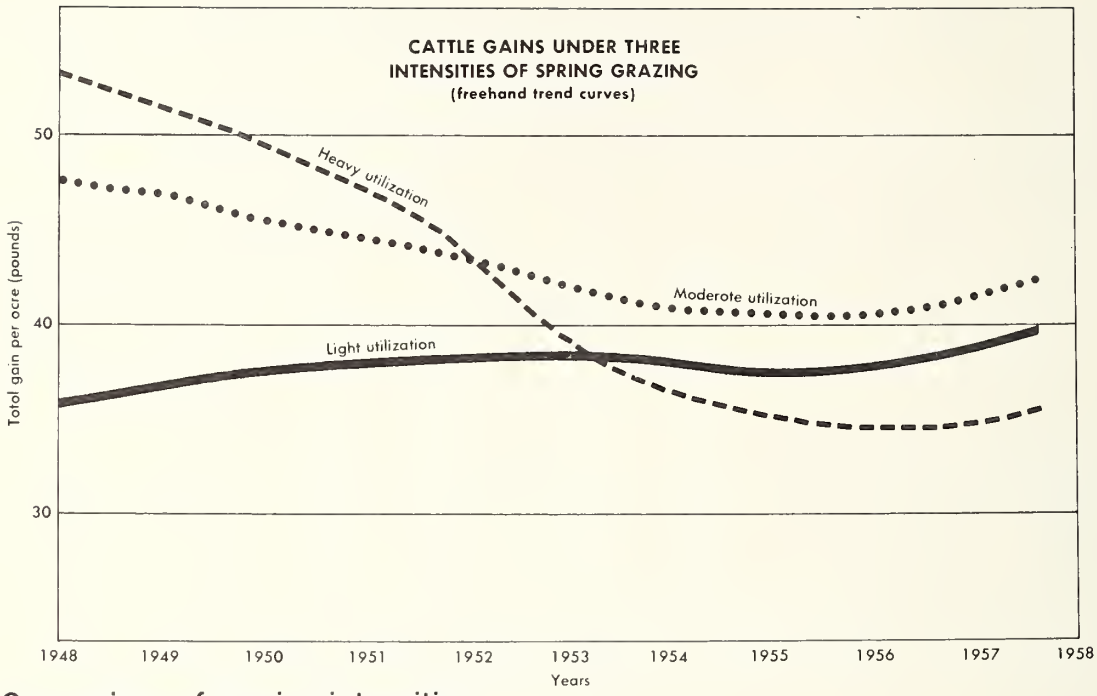
The intensities of grazing were:

1. **Light** (grass utilization, 53 percent).
2. **Moderate** (grass utilization, 65 percent).
3. **Heavy** (grass utilization, 80 percent).

Lightly grazed wheatgrass pasture stocked to utilize about 50 percent of current growth during the spring season. Grazing at this light intensity tends to increase the accumulation of old growth and the development of unpalatable wolf plants.

Moderately grazed crested wheatgrass range. Over the years, grazing at a rate of 65 percent of forage production has provided the best per-acre gains at Benmore for all classes of cattle except lactating cows.

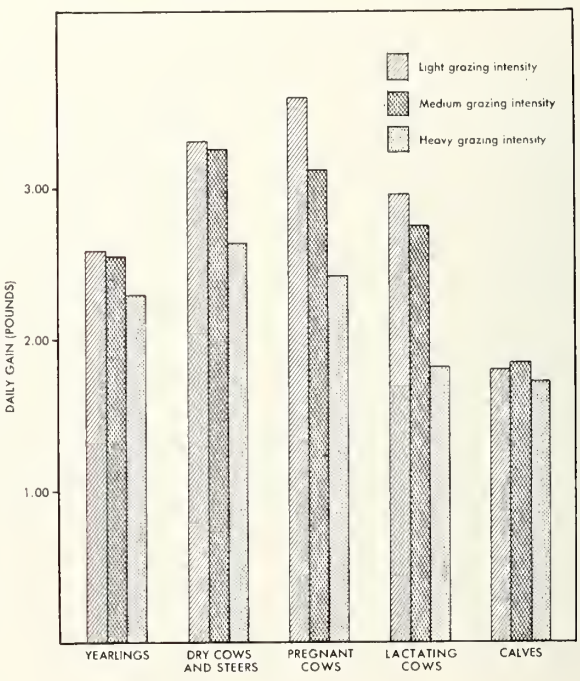
Heavy grazing of this crested wheatgrass range initially gave high per-acre gains, but encouraged the reinvasion of sagebrush. After 2 years of grazing, per-acre gains dropped below those for moderate grazing, and after 6 years gains were lower than those for light grazing.

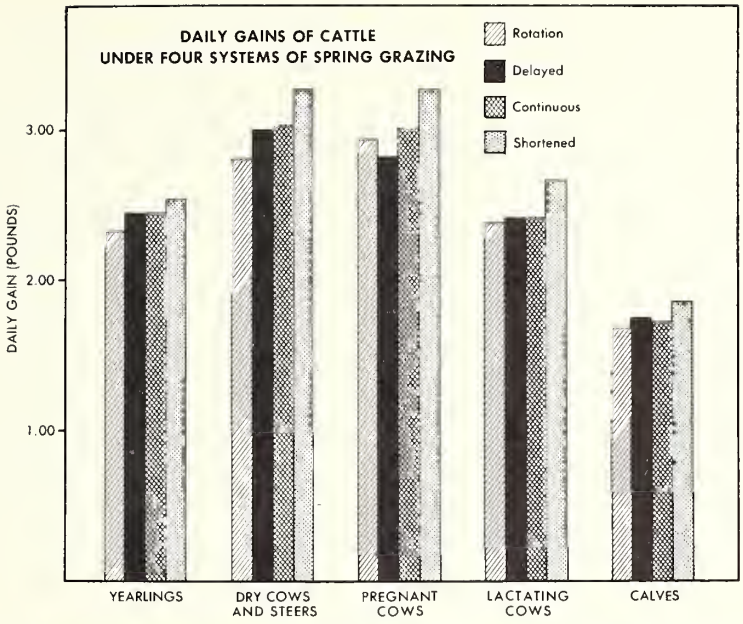


Comparison of grazing intensities. Per-acre gains under **heavy grazing** were initially high, but dropped below those for **moderate grazing** after the second year. After 6 years, per-acre gains for heavy grazing declined below those for **light grazing.** On seeded range at Benmore moderate grazing provided the best long-term production (42.8 pounds per acre for the season, compared to 39.9 and 37.1 pounds for heavy and light grazing, respectively). For best gains and sustained forage production, utilization rates should be between 50 and 60 percent of the available grass.

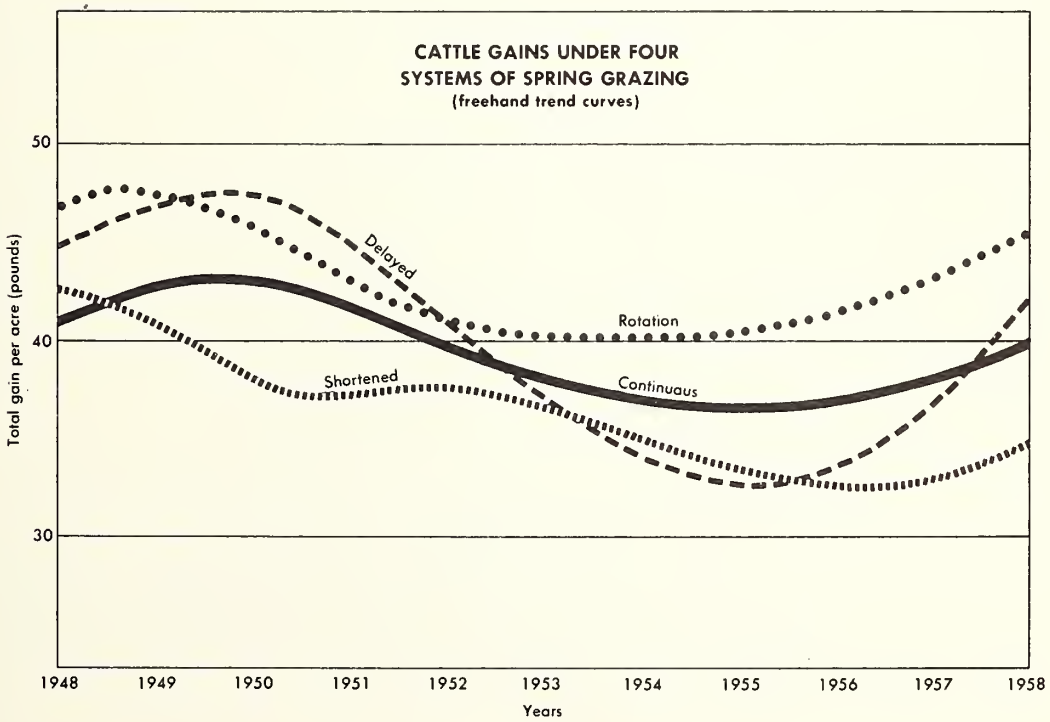
Heavy grazing produced the lowest daily weight gains for all classes of cattle. Light grazing provided the best daily gains per animal, but because of lighter stocking, produced lower gains per acre than did moderate grazing. Per-acre gains declined under heavy grazing because it was necessary to reduce the number of grazing animals as forage yields declined.

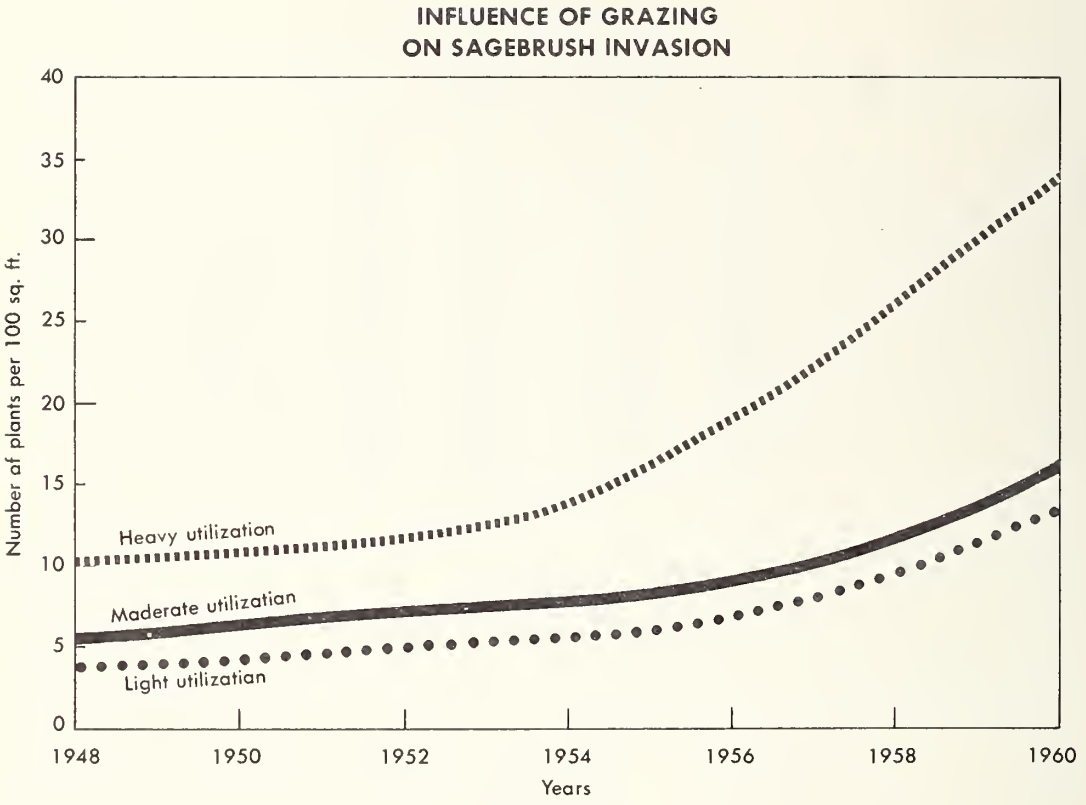
DAILY GAINS UNDER THREE INTENSITIES OF SPRING GRAZING





Comparison of grazing systems. Although the shortened grazing system provided the highest average daily gains for all classes of cattle, the highest gains per acre resulted from either rotation or delayed grazing. (Rotation was superior 7 out of the 11 years of the test.) Average seasonal gains per acre for the 11-year period were: rotation, 42.6 pounds; delayed, 40.6 pounds; continuous, 39.0 pounds; and shortened, 37.3 pounds.





How grazing affected the range. Since these pastures were seeded in the late 1930's, the most striking change over the years has been invasion by big sagebrush and rubber rabbitbrush, which were largely plowed out during the dryfarming period and again when the land was prepared for seeding. Sagebrush tended to increase between 1948 and 1960, but the increase was slight under light and moderate grazing. Heavy grazing (80-percent utilization) led to serious reinvasion of seeded range by sagebrush.

Brush, good and bad. In the Benmore area, sagebrush is harmful to seeded range, but rubber rabbitbrush is not. In fact, researchers have found that yields and quality of grass tend to be better under scattered rabbitbrush than in the open or under sagebrush. The reasons for this difference in effect can be explained by the difference in root systems and growing periods of rabbitbrush and sagebrush. Rabbitbrush has comparatively few lateral roots in the upper soil to compete with grass, whereas big sagebrush roots are highly developed in the surface soils. Further, the growth periods of sagebrush and wheatgrass coincide, whereas most of the growth of rubber rabbitbrush occurs after wheatgrass has matured.

Halogeton may become widespread on heavily grazed crested wheatgrass range, particularly where soil salts are found in relatively high concentrations.

Halogeton grows vigorously on heavily grazed crested wheatgrass range outside permanent livestock exclosure, but is not present inside the fence, where there is vigorous competing vegetation.

Halogeton. In 1952 this noxious plant was discovered on the Benmore Experimental Range and became an object of study. Researchers found that the growth of halogeton is favored by:

- High summer rainfall.
- Heavy grazing.
- High concentration of soil salts.

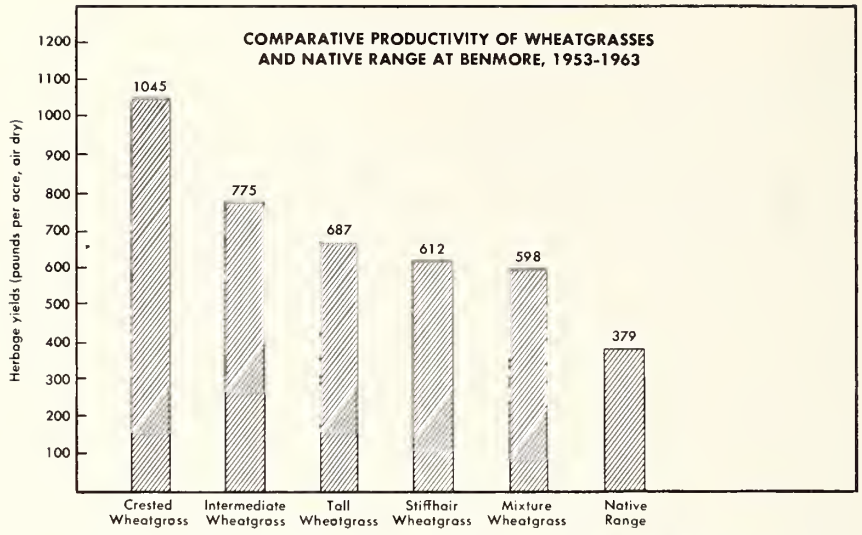
Halogeton is more prevalent on ranges heavily grazed in the spring than on moderately or lightly grazed range. On the latter ranges, halogeton is mainly confined to localized heavily grazed spots and to areas with high concentrations of soil salts. These areas frequently coincide — cattle tend to overgraze areas with high salt concentrations.

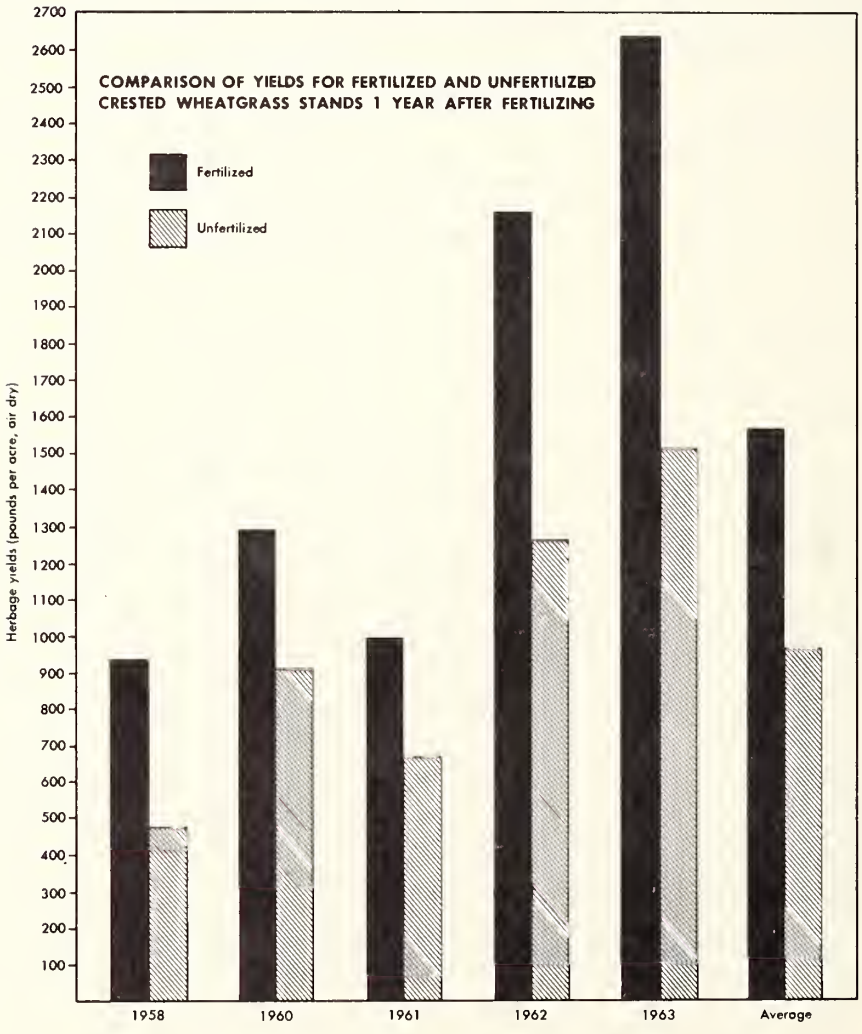
Changes in vegetation. One of the beneficial effects of seeding and controlled grazing was the decline of cheatgrass under all intensities of grazing. This decrease was to some extent offset by increases in bulbous bluegrass and low quality herbaceous species.

FERTILIZATION AND GRAZING STUDIES

Research at Benmore by Utah State University includes studies of various species of introduced grasses for range seeding, methods of seeding, and range fertilization.

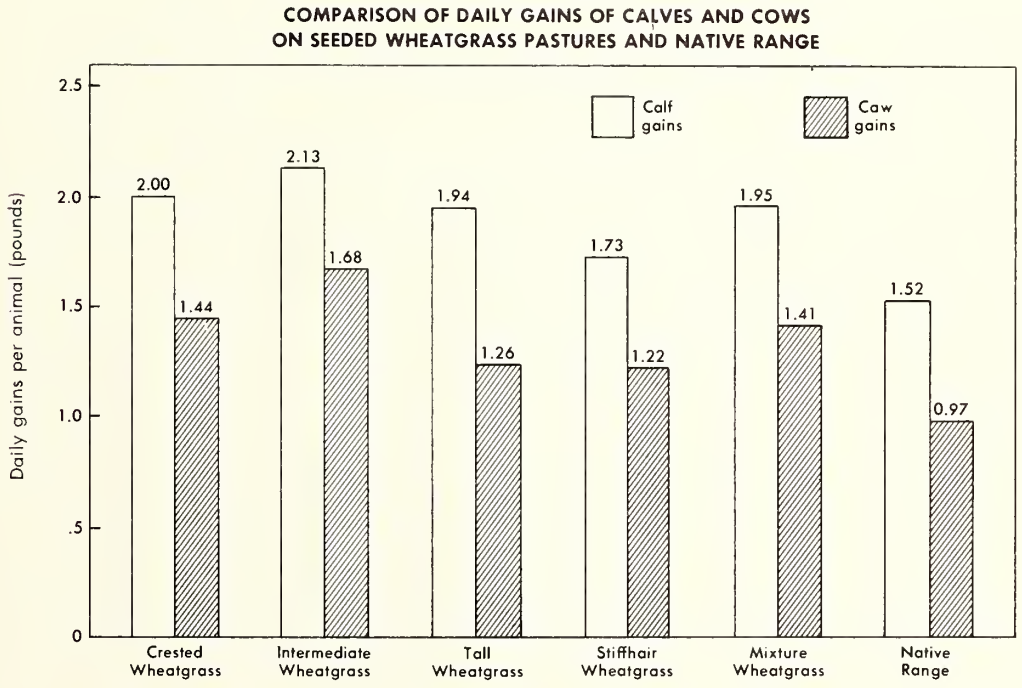
Herbage yields from seeded wheatgrasses. Over the 10-year period from 1953 to 1963, crested wheatgrass produced more forage than any of the other grasses tested on experimental ranges seeded in 1949. However, average yields varied by as much as 500 percent during this period. All the seeded ranges outproduced brushy native range by a wide margin.


COMPARATIVE PRODUCTIVITY OF WHEATGRASSES
AND NATIVE RANGE AT BENMORE, 1953-1963
Herbage yields (pounds per acre, air dry)
1200
1100
1000
900
800
700
600
500
400
300
200
100
1045
775
687
612
598
379
Crested Wheatgrass
Intermediate Wheatgrass
Tall Wheatgrass
Stiffhair Wheatgrass
Mixture Wheatgrass
Native Range


COMPARISON OF YIELDS FOR FERTILIZED AND UNFERTILIZED
CRESTED WHEATGRASS STANDS 1 YEAR AFTER FERTILIZING
Fertilized
Unfertilized
Herbage yields (pounds per acre, air dry)
2700
2600
2500
2400
2300
2200
2100
2000
1900
1800
1700
1600
1500
1400
1300
1200
1100
1000
900
800
700
600
500
400
300
200
100
1958
1960
1961
1962
1963
Average

Effect of fertilizer on forage yields. Phosphorus and nitrogen fertilizers have been experimentally applied to crested wheatgrass ranges since 1957. Phosphorus did not increase forage yields appreciably, but application of 60 pounds of nitrogen increased yields as much as 1,125 pounds per acre in a favorable year. The average increase in forage yields the first year after application of nitrogen was 598 pounds per acre; "carryover effect" produced an average increase of 200 pounds of forage the second year after application, but none for the third year. Thus, the average total increase in yield for five separate experiments approximated 800 pounds per acre.

Livestock gains on different species of wheatgrass. All seeded ranges (grazed at light to moderate rates from June 1 to July 15) produced greater livestock gains than did native sagebrush-grass range. Gains for cows and calves tended to be highest on intermediate wheatgrass pastures and lowest on pastures seeded with stiffhair wheatgrass.



CURRENT GRAZING STUDIES

Completion of the 11-year study of spring grazing techniques by no means closed out the research program at Benmore. Many problems in management of wheatgrass range remained to be solved. The U. S. Forest Service and Utah State University have pushed ahead with additional studies of range utilization, including research on the effect of extending the cattle grazing season, use of sheep to control brush invasion, effects of fertilizing seeded range, and use of additional species of wheatgrass.

Cattle grazing — spring, summer and fall. Past cattle grazing studies were largely confined to investigation of spring grazing (April through June). Since 1961, cattle have been grazed on some ranges at Benmore from April to December. Some preliminary findings are:

- Cows, yearlings, and calves made good gains during spring grazing of seeded ranges.
- Gains made by yearlings and calves were reasonably good throughout the summer and early fall; fall and summer gains for cows were low.
- Supplemental feeding with soybean meal (¾ pound per head per day) had little influence on cattle gains in summer but provided increased gains in the fall.

Daily gains of cattle on supplemented crested wheatgrass range:

	Yearlings		Cows		Calves	
Grazing period	No Supplement	Supplement	No Supplement	Supplement	No Supplement	Supplement
Early spring	2.72		2.28		1.70	
Late spring	1.87		1.62		1.63	
Summer	1.00	0.96	0.20	0.27	1.52	1.71
Fall	0.22	0.67	-0.36	0.39	1.57	1.69

Fall sheep grazing. Studies were begun in 1962 to determine if brush invasion can be controlled by fall sheep grazing. Some preliminary results of these studies are:

- Where brush invasion was moderate sheep utilized about 30 percent of big sagebrush and rubber rabbitbrush, but only 5 to 10 percent where brush was heavy.
- Utilization of crested wheatgrass averaged 45 percent where brush invasion was moderate, but 65 percent where brush was abundant.
- In 1962, when there was little summer rainfall, sheep ate mainly the seedheads of dry grass in the fall. In 1963 sheep preferred green regrowth resulting from summer rains, but also utilized considerable amounts of dry herbage.
- Although fall sheep grazing may have improved the range, weight loss in sheep exceeded economical limits. Greatest weight loss occurred on areas with heavy brush. Average poundage lost per sheep during the fall grazing period was:

	1962	1963
Heavy brush	13.4	8.3
Moderate brush	7.4	1.5

Before grazing by sheep, big sagebrush to right of fenceline was similar in size and vigor to brush in the ungrazed range to left of fenceline. Sheep browsed sagebrush heavily in areas of moderate brush invasion such as this.

RANGE MANAGEMENT PUBLICATIONS

The following bibliography lists publications on range management research conducted wholly or partially at the Benmore Experimental Area. Publications marked with an asterisk (*) are available from issuing office; unmarked publications are available in libraries:

Bennett, James A., L. A. Stoddart, and L. E. Harris.
1949. Should range heifers be bred as yearlings? Utah Farm and Home Sci. 10(2):3,9.

Edwards, Irvin Fred, and L. A. Stoddart.
1944. New range cattle experiment initiated. Utah Farm and Home Sci. 5(4): 10-11.

Frischknecht, Neil C.
1956. Effects of various grazing treatments on crested wheatgrass. Wash. State Col., Dept. Anim. Husbandry Stockmen's Handbook. 1956:28.

Frischknecht, Neil C.

1956. Managing crested wheatgrass for greatest cattle gains. Wash. State Col., Dept. Anim. Husbandry Stockmen's Handbook. 1956:29-30.

1961. Sagebrush versus rabbitbrush invasion of crested wheatgrass range. Abstracts of papers, 14th Ann. Mtg. Amer. Soc. Range Mangt. Salt Lake City, Utah, pp. 38-39.

1962. Factors influencing brush invasion of crested wheatgrass range. Ecol. Soc. Amer. Bull. 43(3):53. (Abstract)

* 1963. Contrasting effects of big sagebrush and rubber rabbitbrush on production of crested wheatgrass. Jour. Range Mangt. 16:72-74.

———, Lorin E. Harris, and Harry K. Woodward.

1953. Cattle gains and vegetal changes as influenced by grazing treatments on crested wheatgrass. Jour. Range Mangt. 6:151-158.

———, and A. Perry Plummer.

1949. A simplified technique for determining herbage production on range and pasture land. Agron. Jour. 41:63-65.

Harris, Lorin E., Neil C. Frischknecht, George Stewart, James A. Bennett, and Harry K. Woodward.

1950. Crested wheatgrass provides excellent spring pasture for beef cattle. Utah Farm and Home Sci. 11(4):71, 93-94.

———, ———, and Robert J. Raleigh.

1958. Cattle gains and vegetal changes as influenced by grazing treatments on crested wheatgrass over a 10-year period. Abstract, Jour. Anim. Sci. 17(4):1209.

———, R. J. Raleigh, N. C. Frischknecht, and J. A. Bennett.

1957. Cattle gains and vegetal changes as influenced by grazing treatments on crested wheatgrass. West. Sect. Amer. Soc. Anim. Prod. 8:XLVII:1-6.

Roberts, N. K., and L. E. Harris.

1961. Alternatives for soil bank lands in Utah. Utah Farm and Home Sci. 22(3): 67, 68, 83-84.

* Smith, Dwight R., Pat O. Currie, Joseph V. Basile, and Neil C. Frischknecht.

1962. Methods for measuring forage utilization and differentiating use by different classes of animals. Symposium, Range Res. Methods, U. S. Dept. Agr. Misc. Pub. 940, pp. 93-102.

Stewart, George.

1945. Range reseeding and grazing use of reseeded lands in Utah. Utah Acad. Sci., Arts and Letters Proc. 22:10.

Walker, Rudger Harper.

1944. Benmore area location of range beef cattle investigations. Utah Farm and Home Sci. 5(2):6-7.

"NEXT IN IMPORTANCE TO THE DIVINE PROFUSION OF WATER, LIGHT, AND AIR . . . MAY BE RECKONED THE UNIVERSAL BENEFICENCE OF GRASS . . . IT INVADES THE SOLITUDE OF DESERTS, CLIMBS THE INACCESSIBLE SLOPES AND FORBIDDING PINNACLES OF MOUNTAINS, MODIFIES CLIMATES, AND DETERMINES THE HISTORY, CHARACTER, AND DESTINY OF NATIONS . . . IT YIELDS NO FRUIT IN EARTH OR AIR, AND YET SHOULD ITS HARVEST FAIL FOR A SINGLE YEAR, FAMINE WOULD DEPOPULATE THE WORLD."

Senator John J. Ingalls
1872


WOOD · WATER · FORAGE
WILDLIFE · RECREATION
FOREST SERVICE
U S
DEPARTMENT OF AGRICULTURE